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Biology of *Chrysoperla carnea* (Stephens) (Neuroptera, Chrysopidae) in Himachal Pradesh*

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ABSTRACT

***Chrysoperla carnea* (Stephens) is one of the most important predators of the cabbage aphid, *Brevicoryne brassicae* (Linn.) infesting cole crops in Himachal Pradesh. The biology of this chrysopid was studied under laboratory conditions on *B. brassicae*. Important morphological characters, body size, duration, etc., of different developmental stages, mating and oviposition behaviour are described. A single larva fed upon an average of 181 aphids in its life span of 12.08 days. A larva could wipe out aphid colonies with initial numbers of 50 and 100 aphids in 4 and 7 days, respectively, but failed to do so in colony with 200 aphids. Development from egg to adult was completed in 24.77 days during mid-May to end-July. The pupal period lasted for 7 to 9 days and the progeny had a sex ratio of 1.2:1 (female:male). The average fecundity was 66 varying between 36 to 123.**

KEY WORDS : *Chrysoperla carnea*, biology, *Brevicoryne brassicae*

Among the better known chrysopids, *Chrysoperla (= Chrysopa) carnea* (Stephens) is one of the most efficient predators of aphids throughout the world (Abdul-Madzhid, 1973; Awadallah *et al.*, 1976; Babrikova, 1981; Adashkevich *et al.*, 1981; Canard *et al.*, 1984; Verma and Shenhmar, 1983). Kadamshoev (1983) reported 20 species of predators and parasites of *Brevicoryne brassicae* (Linn.) (Homoptera, Aphididae) in U.S.S.R. including the more active *Coccinella septempunctata* Linn. (Coleoptera, Coccinellidae) and *C. carnea*. In India, the more common species reported from North-West is *C. scelestes* Banks (Nasir, 1947; Mehra, 1965; Thakur and Pawar, 1986). However, in many earlier reports, the chrysopid predators were mentioned as *Chrysopa* sp. and not identified upto species level (Kotwal *et al.*, 1984; Thakur and Pawar, 1986). The present paper reports the biology of *C. carnea* feeding on *B. brassicae*, a serious pest of cruciferous vegetable crops like cauliflower, cabbage and knol-khol, in the mid-hill regions of Himachal Pradesh.

MATERIALS AND METHODS

Six week old seedlings of cauliflower (Snowball, K1) were transplanted in the second week of October at 60 cm x 60 cm spacing. All the recommended cultural practices were followed in order to provide congenial environment for natural development of the cabbage aphid, *B. brassicae* and its natural enemies. The crop was kept essentially free from insecticidal applications.

Adults of *C. carnea* were collected with the help of a light trap installed in the field and held in glass chimneys (20 cm x 15 cm) with their tops covered with black cotton cloth. Each chimney was provided with 30% honey soaked in a cotton swab and maize pollen as a source of food. The females laid the eggs on the exposed side of the black cloth and sometimes on the sides of the chimney.

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Table 1. Linear measurements and durations of developmental stages of *C. carnea* on *B. brassicae*

Developmental Stage	Measurment in mm (n=10)				Duration in days [a]	
	Length		Breadth		Mean ± S.E.	(Range)
	Mean	(Range)	Mean	(Range)		
EGG	0.84	(0.80-0.89)	0.34	(0.31-0.37)	4.00 ± 0.00	(4-4)
LARVA						
First instar	1.92	(1.80-2.10)	0.57	(0.48-0.66)	3.85± 0.10	(3-4)
Second instar	3.96	(3.64-4.12)	1.20	(1.08-1.32)	3.66 ± 0.14	(3-4)
Third instar	6.28	(5.82-6.44)	1.94	(1.76-2.12)	4.58 ± 0.19	(3-5)
Total larval duration	–	–			12.08 ± 0.20	
PUPA	–	–	3.31*	(3.16-3.58)	8.69 ± 0.20	(7-9)
Duration from egg to adult emergence	–	–			24.77 ± 0.36	
ADULT						
Male	7.64	(6.36-8.82)	19.88**	(18.06-23.62)	35.90 ± 2.11	(27-44)
Female	8.72	(6.94-9.84)	22.64**	(18.92-25.60)	40.60 ± 2.05	(28-51)

* Diameter ** Width across wing span

[a] Number of specimens used for working out averages : egg = 250, larva = 15, pupa = 12, adult = 7 of each sex.

On hatching, the larvae were held individually in glass specimen tubes (2.5 cm x 10 cm) and offered cauliflower leaves with known number of *B. brassicae* daily. Observations were taken on the duration of development of each stage, its size and distinguishing characters, mating and oviposition behaviour as well as fecundity.

The predation potential was determined by computing the number of aphids consumed by the larva in the entire larval stage. The feeding efficiency was ascertained by offering individual colonies with initial number of 50, 100 and 200 aphids to the 3 - day old larva and recording the time taken to devour the colony and/or enter into pupation. The study was undertaken during mid-May to end-July when the temperature fluctuated between 33.8 and 21.8°C and relative humidity between 84.8 and 48.9 per cent.

RESULTS AND DISCUSSION

Eggs were pedicellate and freshly laid eggs were light green in colour but became grey at maturity. The average hatchability was 66.4 per cent. The incubation period was 4 days. Verma and Shenhmar (1983) reported it as 3 days at 27°C, whereas, Kuznetsova (1969) reported it to vary between 6.4 to 6.8 days at 27°C and 2.3 to 2.6 days at 35°C. Shorter incubation period of 4 days at 25°C was reported by Butler and Ritchie (1970) in comparison to 13 days at 15°C. The larval stage consisted of three instars. The yellowish- brown larva had a greenish-yellow head with the dark lines. Thoracic and abdominal segments also had longitudinal lines. Second instar did not show changes in coloration and other morphological characters except the size (Table 1). In third instar larvae, the colour changed to light yellow. The larval stages occupied an average duration of 12.08 days during May. Pasqualini (1975) reported the larval period as 14.8 days at 20°C while Awadallah *et al.* (1976) reported 13.5 days at 28°C whereas, Verma and Shenhmar (1983) reported 8.3 days as the larval period at 27°C. This seems reasonable as in this study, the rearing was done at temperature lower than 27°C.

Table 2. Time taken by *C. carnea* larva to devour *B. brassicae* colonies with different initial populations and corresponding rise in aphid numbers in control colonies

Initial Number of aphids/ colony	Time taken (days) to consume the colony	Corresponding number of aphids in control (no. predator larva) colonies after (days)						
		3	4	5	6	7	8	9
50	4	76	109					
100	7			219	363	428		
200	9 *					827	1032	1246

* Larva entered into pupation, 72 aphids alive Number of replications = seven

The predaceous larva killed its prey by sucking the body contents leaving the hard chitinized parts. The average consumption of the larva was 13, 42 and 125 *B. brassicae* in its first, second and third instars, respectively, with mean consumption of 181 aphids per larva. The mean prey consumption of *C. carnea* larva, when fed on *Myzus persicae* Sulz., was 308 (Burke and Martin, 1956), 386 (Hafez and Abd-el-Hamid, 1965), 393 (Sundby, 1966) and 385 (Scopes, 1969). Such variations and comparatively low consumption in the present studies may be attributed to the prey species as well as different environmental factors. Zaki (1987) reported that consumption rate increased with rising temperature and decreasing relative humidity and on an average a larva consumed 273.4 aphids at 30°C and 40 per cent relative humidity.

Aphid colonies with initial number of 50, 100 and 200 aphids, were offered individually to 3 - day old larvae. The larva took 4 and 7 days to devour colonies with 50 and 100 aphids but failed to do so to colony with 200 aphids as there were still 72 aphids alive in the colony on the 9th day when the larva entered the pupal stage (Table 2). These results suggest that *C. carnea* larva would efficiently decimate a colony with 100 aphids but would fail to do so to colony with 200 aphids. The larvae pupated in creamy white cocoons after a short prepual period. The pupal stage lasted for 8.69 days. Similar duration of pupal period was reported by earlier workers (Toschi, 1965; Butler and Ritchie, 1970; Awadallah *et al.*, 1976). Egg to adult emergence took 24.77 days.

The adult was bright green with metallic lustre in its eyes. The antennae were delicate, filiform and larger than the body. The females were usually larger than males with swollen abdomen and a creamy-yellow enlarged lining on 2-5 abdominal sternites. Among the laboratory-reared specimens (n = 30), the female to male ratio was 1.2:1.

Copulation occurred in the dark and lasted for an average duration of 29.4 minutes. After mating, it took 5 days for oviposition. On an average, oviposition period lasted for 30.2 days during which time the female laid an average number of 66 (range 36-123) eggs. In contrast, higher fecundity has been reported earlier at different temperatures but almost similar oviposition period (Sundby, 1966; Pasqualini, 1975). This difference may be attributed to the effect of mating and nutritional status of the adult chrysopids as pointed out by Jones *et al.* (1977) for this species. The average longevity of mated males was 35.9 days whereas, that of females was 40.6 days. Kuznetsova (1969) reported a longevity of 80 to 82 days at 20°C and 80 per cent relative humidity. This variation may be ascribed to differences in rearing conditions.

The present study, besides providing information on the biology of the chrysopid, revealed that in the temperate region of Himachal Pradesh, *C. carnea* could be relied upon as an efficient predator of *B. brassicae* in the early stages of aphid population build-up.

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